# PROBABILITY FOR DECISIONS IN ANCIENT GREECE

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## Summary

The use of the probable in decision-making was analyzed by the skeptic, Carneades, in the second century B.C. His work involved the use of a Greek word for probable and a meaning for probable different from those discussed by Sambursky (1956) in his study of the probable in ancient Greece.

## 1. Two Greek concepts of probability

Probability in the scientific community is a tool for handling measurement errors, individual differences, and lack of precision in formulas and models. Probability provides a measure for these sources of variability. When the variability is taken into account, the probable is that which is likely.

Probability in the business community is a tool for handling incomplete information in decision-making. Information is used to arrive at a degree of belief, a probability or an expectation, which is of sufficient magnitude to allow choice. After this treatment of all available information, the probable is that which is preferred.

Though the mathematics of these two concepts of probability may often be the same, philosophically they have few points in common. The former is a notion of the probable which attempts objectivity, offering no value judgments and proposing no future plan of action. The development in ancient Greece of this concept,

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εἰκός, has been studied by Sambursky (1956)[1]. It developed primarily among the Stoics in an environment of strict determinism. The latter is a notion of the probable necessarily subjective, using subjective judgments about what is appropriate information to arrive at the value judgments and proposed plans of action which are excluded from the notion εἰκός. In ancient Greece the development of this concept of the probable, πιθανος, is to be found in the work of the skeptics of the Third Academy. This is a completely subjective environment, allowing that man is incapable of knowledge, only capable of belief.

Both Greek words, εἰκός and πιθανος, are translated as probable, but the synonyms for probable form distinct groups. εἰκός may be translated as likely, reasonable, just, fit, or proper. πιθανος may be translated as persuasive, attractive, pleasing, or acceptable (Pickering (1846))[2]. While the adjectives likely, reasonable, just, fit, and proper imply something universal and objective about their subject; persuasive, attractive, pleasing, and acceptable imply a subjective judgment by some individual or group about their subject.

An example may demonstrate the distinction being made. When the weather report indicates a forty percent chance of rain, if this can be accepted as an objective judgment, it is probable in the εἰκός sense that it will not rain. But in the πιθανος sense it is probable that it will rain because I am convinced that it is expedient to carry an umbrella. I am persuaded to act as if it were going to rain. Thus, while εἰκός is closely related to modern conceptions about probability, πιθανος may be closer to the Bayesian concept of expected loss.

## 2. Carneades, the skeptic

Carneades was the most accomplished speaker in Greece in the second century before Christ. He was unsurpassed in argument, able to convince people of one viewpoint one day and the opposing viewpoint the following day. While in Rome to

defend the Greek schools and the study of philosophy, Carneades convinced the Romans that they acted with justice and returned the following day to demolish all arguments for an objective justice.[3] The only philosophy for this academic philosopher, the head of Plato's Academy and "unquestionably the greatest philosopher in Greece in the four centuries from Chrysippus to Plotinus"[4], was a thoroughgoing skepticism. If rebuttal is possible for any argument, no argument can be known to be true. Carneades spent his life arguing against all forms of dogmatism, especially the Stoic "truths". When the Stoics attacked his skepticism he carried it to its limit, even denying anything stronger than belief in the truth of the premises of his skepticism.

A major difficulty inherent in skepticism was the problem of rational action. By postulating complete knowledge, complete information, the dogmatic philosophers of his age found constructive bases for laws of conduct. The skeptic, withholding any judgment of truth, has no alternative but to refrain from action or propose rules for action in the face of uncertainty. Aristotle is credited with considering probability as the basis for judicial judgment.[5] The skeptic made probability crucial in all decisions by denying any possibility of certainty. Arcesilaus of Pitane (315-240 B.C.) was the first academic skeptic to head Plato's Academy. He was first to propose probabilities as the basis for all action. Carneades is the focus of attention because he developed the notion of probability, explaining its function and its characteristics. His study of probability has been cited in the philosophic literature as "the most careful analysis of the phenomenon (of choice)."[6]

## 3. Carneades' notion of probability

After arguing that man cannot know anything and must always suspend final judgment, something must be developed to allow man to act despite his uncertainty. Arcesilaus met the argument that his reasoning forced him to remain perpetually

indecisive by stating that even among his critics, the Stoics, decisions were not based on certainties. The probable must always be part of the reasoning which leads one to a decision. Arcesilaus proposed probability as the key to decision making, but nothing is recorded of any efforts to examine its functioning or to systematically study it. Therefore attention is concentrated on Carneades.

Carneades became leader of the Academy one hundred years after Arcesilaus, and was faced with the same arguments from the Stoics as his predecessor. His arguments were often further refined and developed versions of Arcesilaus' arguments. He developed a notion of probability as a basis for decision and gave examples, showing how to use it and how it differed from the Stoic notions of bases for decisions.

Probability (πιθανότης) has three basic classes. (A) The probable or the plausible (πιθανή) is that which, taken by itself, gives the impression of truth; it cannot be rejected without further study. (B) The probable and undisputed is that which gives the impression of truth and is not contradicted by any related notion. This might be called plausible and consistent. (C) The probable, undisputed and tested is that which has been examined along with all related notions and found to be corroborated. There are gradations within each of these classes, so that it is possible to talk about the relative probabilities of events which are at the same level in terms of the decision-maker's analysis. In decision making it is necessary to choose an appropriate class of probabilities and then act based on the positions of events within that class.

(A) Level one, the plausible

A man pursued by enemies comes to a ditch and considers its potential as a hiding place. It is plausible to him that there are enemies waiting in the ditch to ambush him. Rather than stop and consider related notions such as which way

the wind is blowing and how his pursuers feel about crouching in ditches he turns aside, avoiding the ditch. The possible loss incurred as a result of joining his enemy in the ditch will be enough to discourage the proposed course of action no matter how unlikely the event of an ambush turns out to be. In this situation it would be poor advice to suggest thorough examination. The probable is the appropriate class of probabilities to consider as a basis for action.[7]

In this example the potential loss is enough to direct the decision process. Another example of decision making at this level is Pascal's wager.

> 'According to the doctrine of chance, you ought to put yourself to the trouble of searching for the truth; for if you die without worshipping the True Cause, you are lost.' — "But", say you, "if He had wished me to worship Him, He would have left me signs of His will." — He has done so; but you neglect them. Seek them therefore; it is well worth it.'[8]

If God existed, the loss due to failure to pursue His truth would be eternal damnation. Therefore, Pascal reasoned that with such a potential penalty a man should conduct himself as if God existed, regardless of his beliefs.

Plausibility is a basis for action when the loss incurred by inaction is great enough. In modern language, the work of level one is the establishment of a loss function over all possible (plausible) states of nature and potential actions. Losses approaching infinity justify action to avoid such a result.

(B) Level two, the plausible and undisputed

If one wishes to decide whether a particular man is Socrates, he does not base his decision on the fact that such an event is possible. One must consider his customary qualities - color, size, shape, speech, dress. One wishes to have the decision depend on plausibility and consistency. The probable and undisputed is the appropriate class of probabilities to consider as basis for action.[9]

The decision maker considers the relevant information which is already available to achieve a degree of belief concerning the question of interest. In decision theory terminology, the work of level two is the establishment of a prior distribution on the possible states of nature. When consideration of the loss function and the prior distribution is properly decisive, action can be based on level two results.

(C) Level three, the plausible undisputed and tested

When there is time, or when the decision is particularly critical no matter which action is chosen, one operates in the probable, undisputed and tested class of probabilities.

> ... on seeing a coil of rope in an unlighted room a man jumps over it, conceiving it for the moment to be a snake (thus acting based on a probability of the first class), but turning back afterwards he inquires into the truth, and on finding it motionless he is already inclined to think that it is not a snake, but as he reckons, all the same, that snakes too are motionless at times when numbed by winter's frost (our seeker of truth has failed to find a strong enough probability against the coil being a snake in the second class of probabilities), he prods at the coiled mass with a stick, and then, after thus testing the presentation received, he assents to the fact that it is false to suppose that the body presented to him is a snake.[10]

The decision maker has considered the danger inherent in snakes, the information available, and the results of his test in deciding how to act. The work of level three is experimentation. The decision maker finishes with a posterior Bayes risk on which to base action.

## 4. Conclusion

A vivid outline of Bayesian decision theory was developed by Carneades to allow skeptics to act. There appears to have been no additional development for almost two thousand years. Only after numerical probability was under investigation did a more thorough analysis of numerically tractable decision problems become possible.

This analysis of the problem of rational decision making emphasizes the intuitive appeal of Bayesian analysis. If this three-stage process is the rational approach to everyday decisions, one might argue that the rational approach to the mathematically tractable problems of science and business must be the numerical development of Carneades' system, the Bayesian system.

## 5. A Comment

Carneades refused to go out to dinner because his work was too important. While eating at home friends occasionally had to move his hands for him because he was too lost in thought. Either because of this dedication to thought or because Carneades was too shrewd a politician, he never put anything in writing. The author has attempted to use only reputable second- and third-hand information. It should be noted that people were still putting words into the mouth of Carneades in 1930. Two important books in which Carneades serves as the proponent of an updated skepticism are: The Sceptical Biologist by Joseph Needham (1930)[11] and The Sceptical Chymist: or Chymico-physical Doubts and Paradoxes, touching the Experiments Whereby Vulgar Spagirists Are want to Endeavor to Evince their Salt, Sulphur and Mercury to be the True Principles of Things by Robert Boyle (1680).[12] In both cases much of his dialogue deals with opinions which are neither explicit nor implicit in his reported opinions.

## Notes


1. S. Sambursky (1956). 'On the possible and probable in Ancient Greece', Osiris, 12, 35-48. [Reprinted in Studies in the History of Statistics and Probability, Volume II, Kendall and Plackett, eds., Griffin, London, 1977.]

2. J. Pickering (1846). A Comprehensive Lexicon of the Greek Language. Wilkins, Carter, and Co., Boston.

3. B. Constant Martha (1905). 'Le Philosophe Carnéade a Rome', pp. 61-134 in Etudes Morales sur L'Antiquité (1905), Librairie Hachette, Paris.

4. R. D. Hicks (1910). Stoic and Epicurean. Charles Scribner's Sons, New York, p. 322.

5. F. Mentré (1908). Cournot et la Renaissance du Probabilisme au XIX$^{e}$ Siècle, Marcel Rivière, Paris.

6. Alfred Schutz (1970). Reflections on the Problem of Relevance. Yale University Press, New Haven and London.

7. Sextus Empiricus. R. G. Bury translation (1935). Against the Logicians. Loeb Classical Library, Harvard University Press, Cambridge, Mass., Sec. 186 (p. 101).

8. Blaise Pascal. W. F. Trotter translation (1910). Thoughts. Harvard Classics, Volume 48, Collier and Son, New York. Section III 'Of the Necessity of the Wager', Sec. 236.

9. Sextus Empiricus (1935). Sec. 178 (p. 97).

10. Ibid. Sec. 187-188 (pp. 101-103).

11. Joseph Needham (1930). The Sceptical Biologist. W W Norton and Co., New York. 'Prefatory Dialogue'.

12. Robert Boyle (1680). The Sceptical Chymist: or Chymico-physical Doubts and Paradoxes, touching the Experiments Whereby Vulgar Spagirists Are want to Endeavor to Evince their Salt, Sulphur and Mercury to be the True Principles of Things. Henry Hall, Oxford.